

Accuracy Characteristics for Final Delivery Scenario Hours 1600-2100 Interfacility

1 Introduction

This document contains scenario characteristics for hours 1600 to 2100 GMT recorded on May 26, 1999 at Memphis ARTCC and cover either the ZME or ZID airspace. Characteristics to be provided are general statistics determined from the scenario on airspace characteristics, aircraft to aircraft and aircraft to airspace encounters, general air traffic, aircraft, flight plan adherence, interfacility traffic flow and deviations in weather forecasts. Definitions of the provided scenario characteristics are provided in Reference[1].

2 Reference

[1] Paglione, M., Oaks, R., Ryan, Dr. H., Summerill, J.S., (Final, January 2000), *Description of Accuracy Scenarios for the Acceptance Testing of the User Request Evaluation Tool (URET) / Core Capability Limited Deployment (CCLD)*, FAA William J. Hughes Technical Center / ACT-250, Atlantic City, New Jersey.

NOTE – Section numbers in this document do not map to those of the reference document.

3 Center Airspace

This section corresponds to Section 3.1 of Reference[1]. The below data corresponds to the ZME Center using the May 20, 1999 ACES chart cycle. Information gathered from running URET PRE, accessing the ZME Center Internet site and local knowledge.

Metric	Definitions	Count
Center Area	Approximate Square Miles	120000
Airports	From URET DU Adaptation List	778
Sectors	From URET DU Adaptation List	110
SAA	Special Activities Airspace	57
APDIA	Automated Problem Detection Inhibited Area	20
SID	Standard Instrument Departure	11
STAR	Standard Arrival Route	10
PAR	Preferential Arrival Route	594
PDR	Preferential Departure Route	346
PDAR	Preferential Departure Arrival Route	124

4 Aircraft Encounter Distributions

The statistics collected in this section characterize aircraft to aircraft encounters. The encounter counts are partitioned by selected minimum horizontal separation intervals, a count of encounters partitioned by standard flight levels, and by vertical phase of flight and aircraft encounter angle. This section corresponds to Section 3.2.1 in Reference[1].

4.1 Count Partitioned by Minimum Horizontal Separation

This section corresponds to Section 3.2.1.1 in Reference[1].

Table 1: Count of Current Plan Aircraft Encounters

Min. Horz. Separation (nm)	Without Adherence	13 Minutes Adherence
$0 \leq d < 5$	191	118
$5 \leq d < 10$	212	127
$10 \leq d < 15$	261	162
$15 \leq d < 23$	581	347
$23 \leq d < 30$	496	286
Total	1741	1040

Table 2: Count of Trial Plan Aircraft Encounters

Min. Horz. Separation (nm)	Without Adherence	20 minutes Adherence
$0 \leq d < 5$	191	109
$5 \leq d < 10$	212	122
$10 \leq d < 15$	261	150
$15 \leq d < 24$	664	373
$24 \leq d < 30$	413	233
Total	1741	987

4.2 Count Partitioned by Altitude for Standard Separation Intervals

This section corresponds to Section 3.2.1.2 of Reference[1].

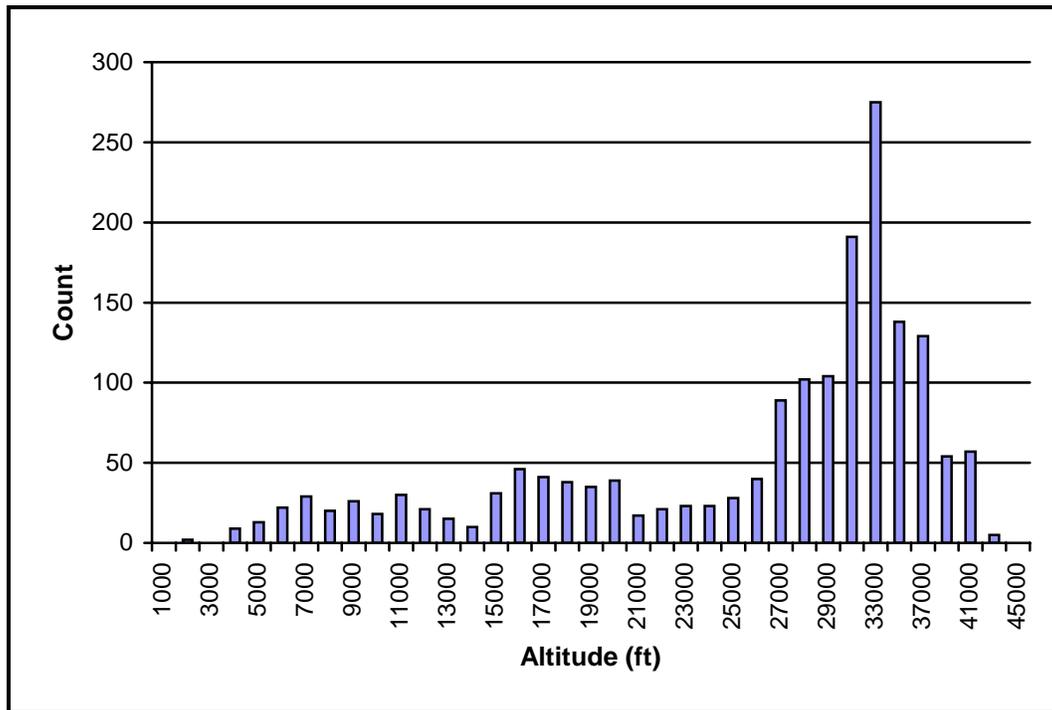


Figure 1: Aircraft to Aircraft Encounters by Altitude

4.3 Count Partitioned by Vertical Phase of Flight and Encounter Angle

This section corresponds to Section 3.2.1.3 of Reference[1].

Table 3: Count of Aircraft Encounters Partitioned by Phase of Flight and Encounter Angle

Vertical Phase	Encounter Angles (deg)				Total
	[0, 45)	[45, 90)	[90, 135)	[135, 180]	
Cruise-Cruise	106	123	61	43	333
Descend-Descend	38	12	10	14	74
Climb-Climb	41	5	5	10	61
Cruise-Climb	192	108	107	150	557
Cruise-Descend	182	106	107	167	562
Climb-Descend	56	11	18	40	125
Unknown	16	7	2	4	29
Total	631	372	310	428	1741

5 Airspace Encounter Distributions

This section provides statistics on aircraft to airspace encounters. Three areas considered are counts partitioned by selected minimum horizontal separation intervals, an encounter count partitioned by standard flight levels, and a count partitioned by vertical phase of flight and airspace encounter angle. Additionally, vertical phase of flight count is separated into top, bottom and side airspace encounters and for encounters with unknown encounter angles. The section corresponds to Section 3.2.2 of Reference[1].

5.1 Count Partitioned by Minimum Horizontal Separation

The section corresponds to Section 3.2.2.1 of Reference[1].

Table 4: Count of Current Plan Airspace Encounters by Horizontal Separation

Min. Horz. Separation (nm)	Without Adherence	13 minutes Adherence
Conflicts ¹	2430	2081
$d = 0^2$	38	32
$0 < d < 7$	912	741
$7 \leq d < 9$	236	175
$9 \leq d < 11$	257	187
$11 \leq d < 16$	592	467
$16 \leq d < 30$	1957	1585
Total	6422	5268

Table 5: Count of Trial Plan Airspace Encounters by Horizontal Separation

Min. Horz. Separation (nm)	Without Adherence	20 minutes Adherence
Conflicts ³	2430	2030
$d = 0^4$	38	31
$0 < d < 8$	1026	813
$8 \leq d < 11$	379	278
$11 \leq d < 13$	224	170
$13 \leq d < 19$	785	623
$19 \leq d < 30$	1540	1190
Total	6422	5135

¹ This count includes encounters that are conflicts. By definition the minimum horizontal separation is zero and the track point actually penetrates the airspace.

² This count includes encounters without valid airspace penetrations, which occurs under two cases: a short duration penetration or an encounter on the actual buffered boundary of the airspace which does not penetrate.

³ This count includes encounters that are conflicts. By definition the minimum horizontal separation is zero and the track point actually penetrates the airspace.

⁴ This count includes encounters without valid airspace penetrations, which occurs under two cases: a short duration penetration or an encounter on the actual buffered boundary of the airspace which does not penetrate.

5.2 Count Partitioned by Altitude

This section corresponds to Section 3.2.2.2 of Reference[1].

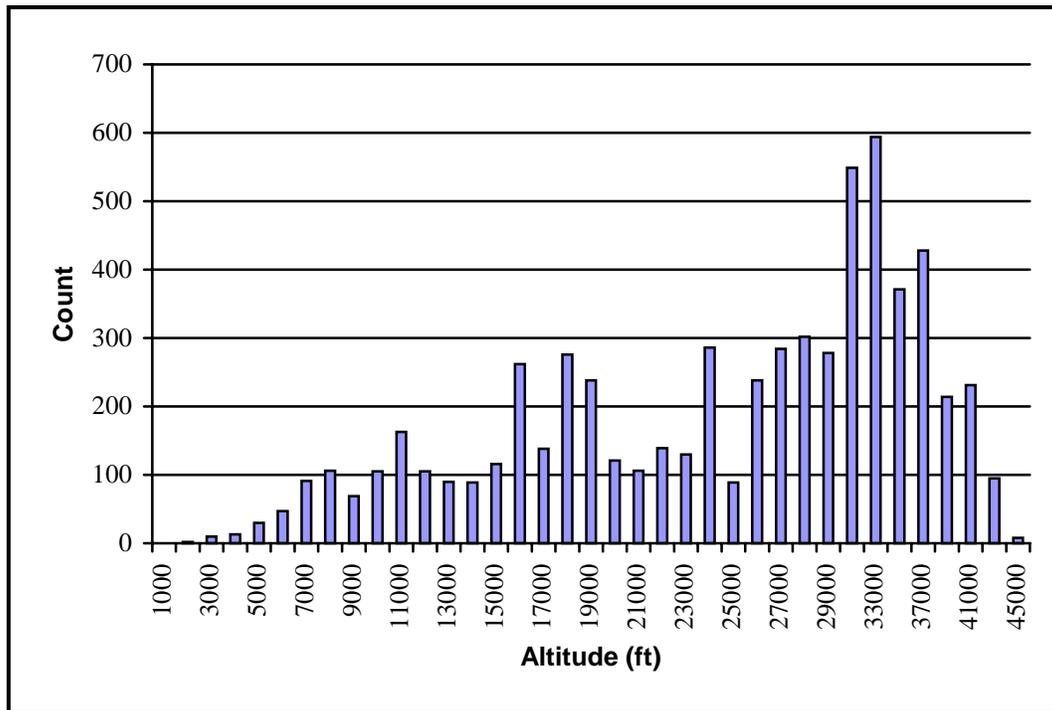


Figure 2: Airspace to Airspace Encounters by Altitude

5.3 Count by Vertical Phase of Flight and Encounter Angle

This section corresponds to Section 3.2.2.3 in Reference[1].

Table 6: Count of Airspace Encounters by Angle and Vertical Phase of Flight for Side Conflicts

Vertical Phase	Encounter Angles (deg)			Total
	[0, 30)	[30, 60)	[60, 90)	
Climb	11	64	144	219
Cruise	219	574	847	1640
Descend	22	60	69	151
Total	252	698	1060	2010

Table 7: Count of Airspace Encounters by Angle and Vertical Phase of Flight for Top and Bottom Conflicts

Vertical Phase	Encounter Angles (deg)			Total
	[0, 30)	[30, 60)	[60, 90)	
Climb	164	0	0	164
Cruise	4	0	0	4
Descend	18	0	0	18
Total	186	0	0	186

Table 8: Count of Airspace Encounters by Vertical Phase of Flight with Unknown Angles

Vertical Phase	Count
Climb	48
Cruise	159
Descend	27
Total	234

6 Air Traffic Distributions

This section provides metrics that characterize the air traffic. The metrics are flight density partitioned by standard flight levels, flight type and sector penetration, statistics on the number of active flights, ground speed statistics, counts of interim altitude and amendment messages, and air traffic maneuvers by altitude and phase of flight. This section corresponds to Section 3.3 of Reference[1].

6.1 Air Traffic Density

This section corresponds to section 3.3.1 of Reference[1]. Detailed statistics on aircraft encounters are provided in Appendix A.

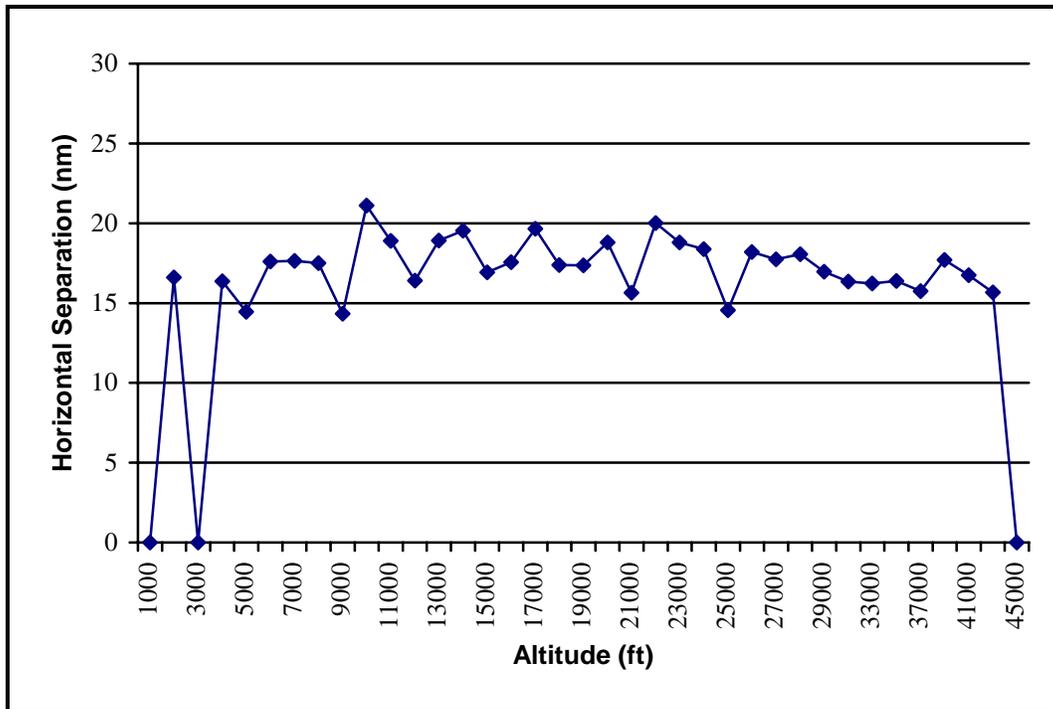


Figure 3: Average Horizontal Separation by Altitude for All Hours

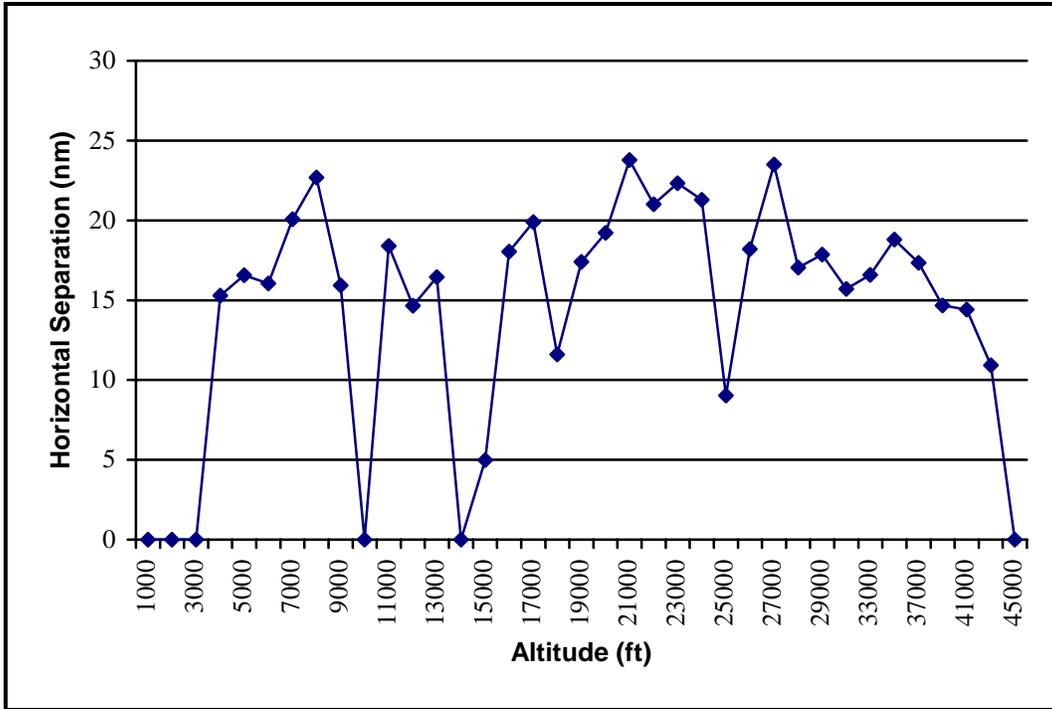


Figure 4: Average Horizontal Separation by Altitude for Hour 1

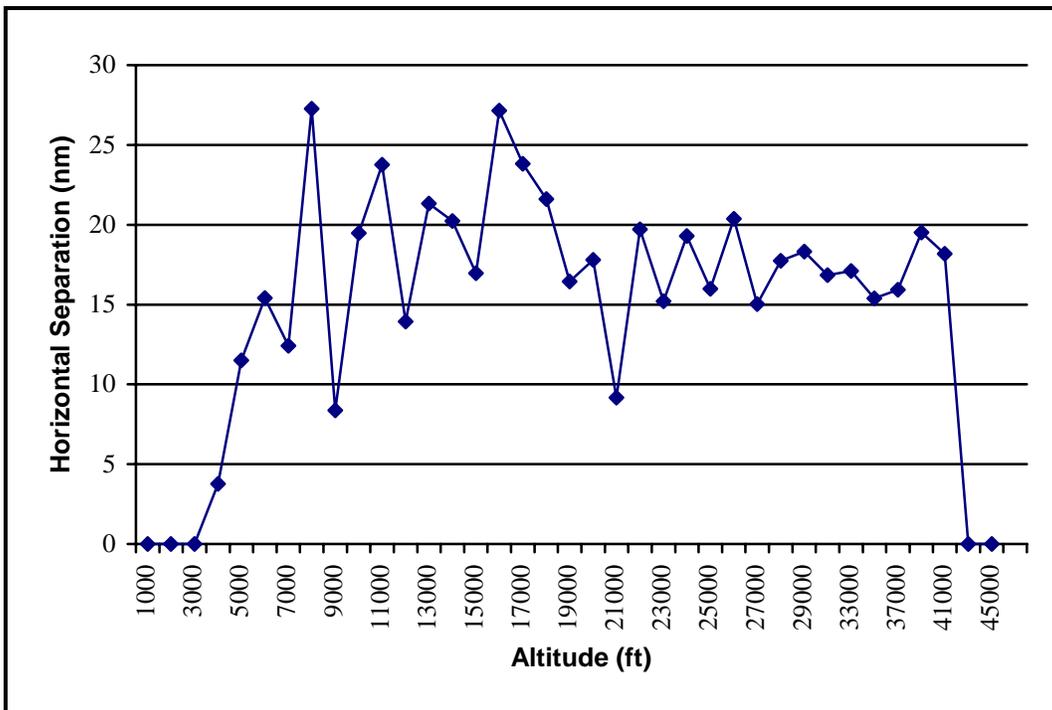


Figure 5: Average Horizontal Separation by Altitude for Hour 2

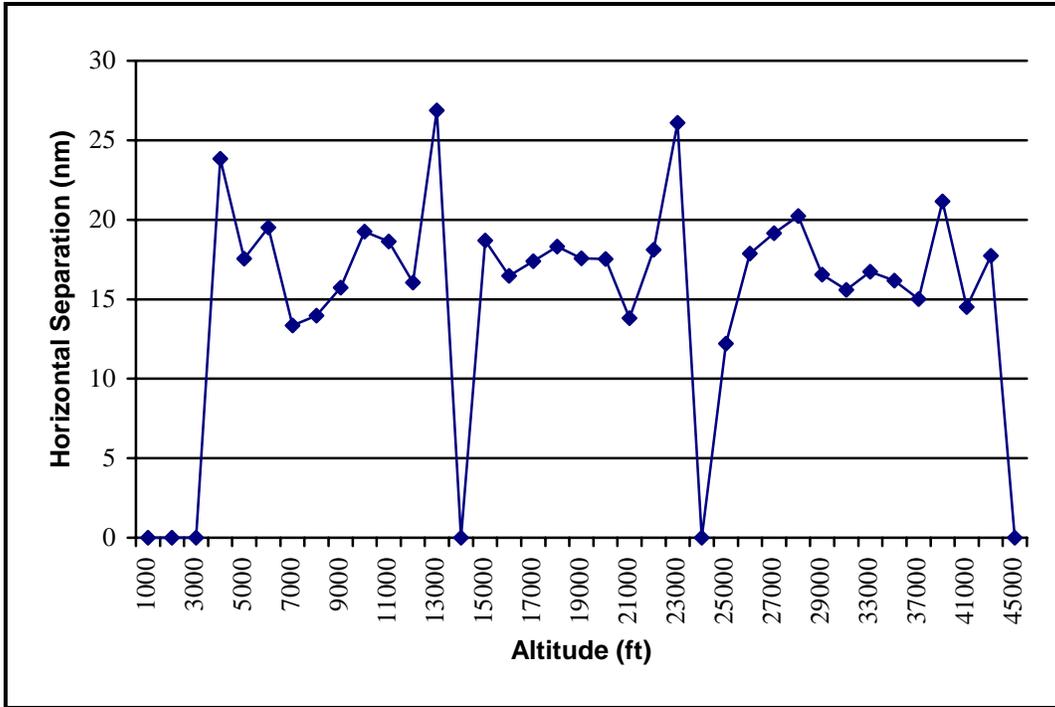


Figure 6: Average Horizontal Separation by Altitude for Hour 3

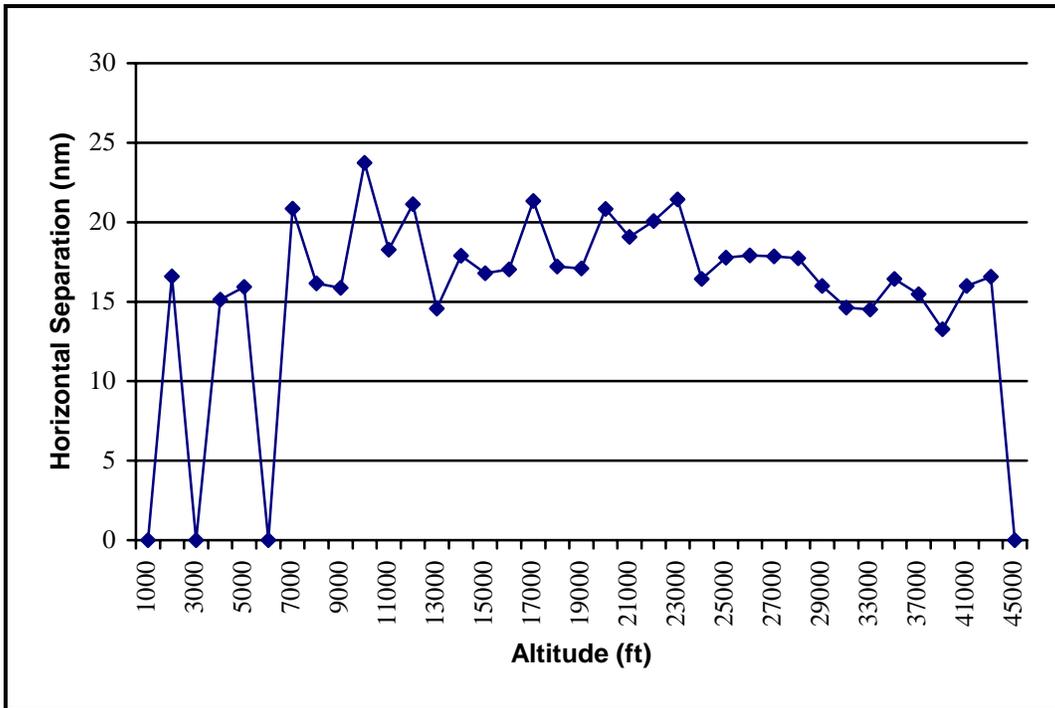


Figure 7: Average Horizontal Separation by Altitude for Hour 4

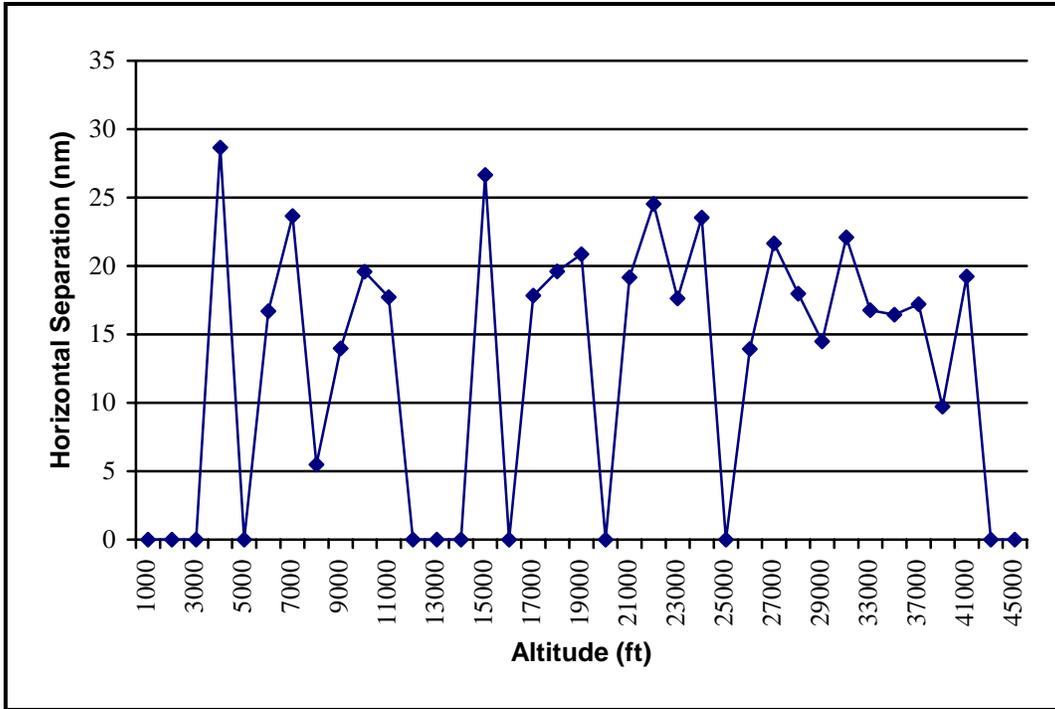


Figure 8: Average Horizontal Separation by Altitude for Hour 5

6.2 Active Flights

This section corresponds to section 3.3.2 of Reference[1].

Table 9: Statistics on Active Flights per Minute Increment

Count Average	Standard Deviation	Maximum Count	Minimum Count
207.977	89.134	312	0

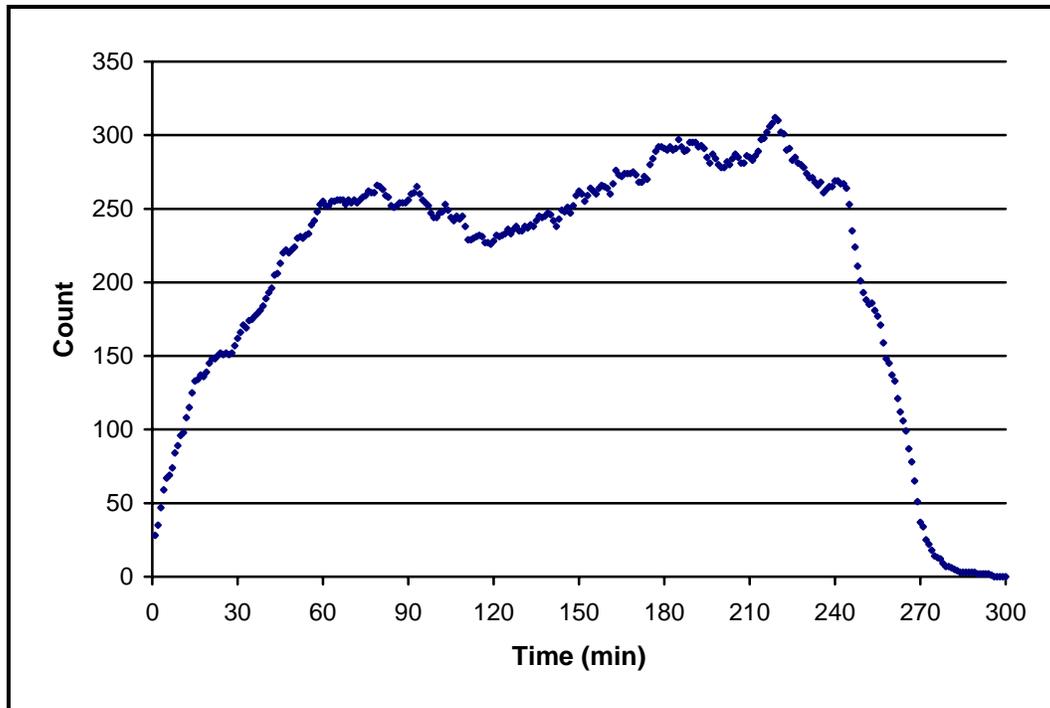


Figure 9: Count of Active Flights per Minute Increment

6.3 Flight Type and Sector Penetration

This section corresponds to Section 3.3.3 of Reference[1].

Table 10: Statistics on Sector Time, Center Time and Sector Penetration by Flight Type

Metric	Arrivals	Departures	Internals	Overflights	All Flights
Average Number of Sectors Penetrated	2.068	2.155	1.865	2.532	2.308
Average Time in Center (sec)	1455.963	1253.234	1419.683	1846.619	1608.269
Average Time in Sector (sec)	669.294	564.729	761.106	720.145	682.292
Percentage by Flight Type	19.400	22.100	7.600	50.800	100.000

6.4 Ground Speed

This section corresponds to Section 3.3.4 of Reference[1]. Detailed statistics on aircraft ground speed are provided in Appendix B.

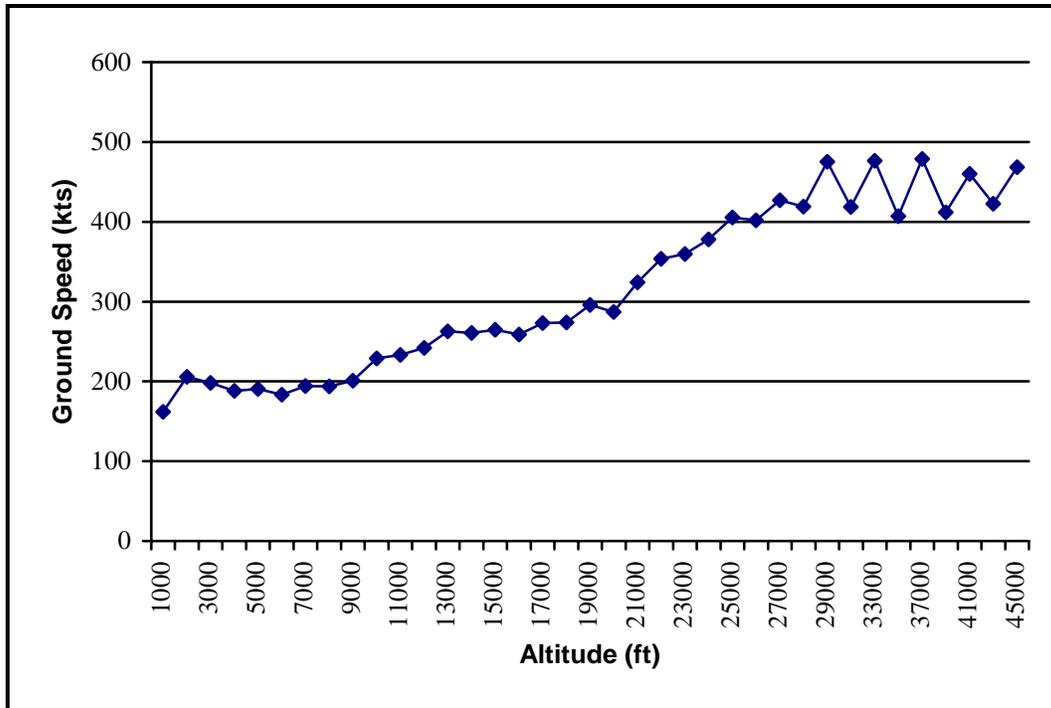


Figure 10: Average Ground Speed by Altitude for All Hours

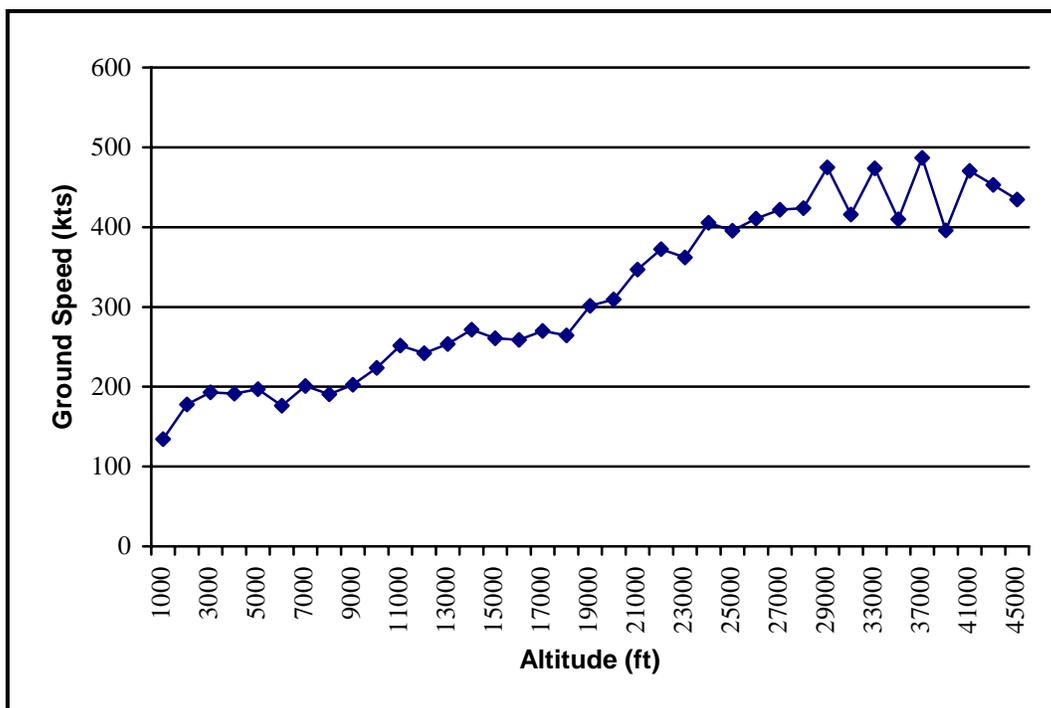


Figure 11: Average Ground Speed by Altitude for Hour 1

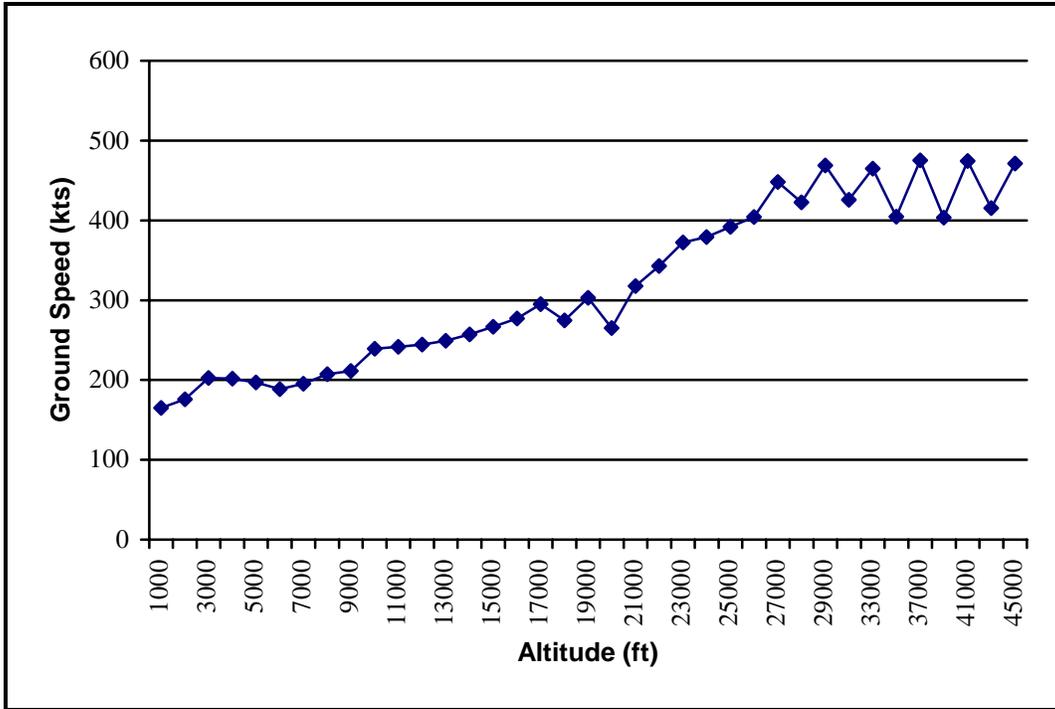


Figure 12: Average Ground Speed by Altitude for Hour 2

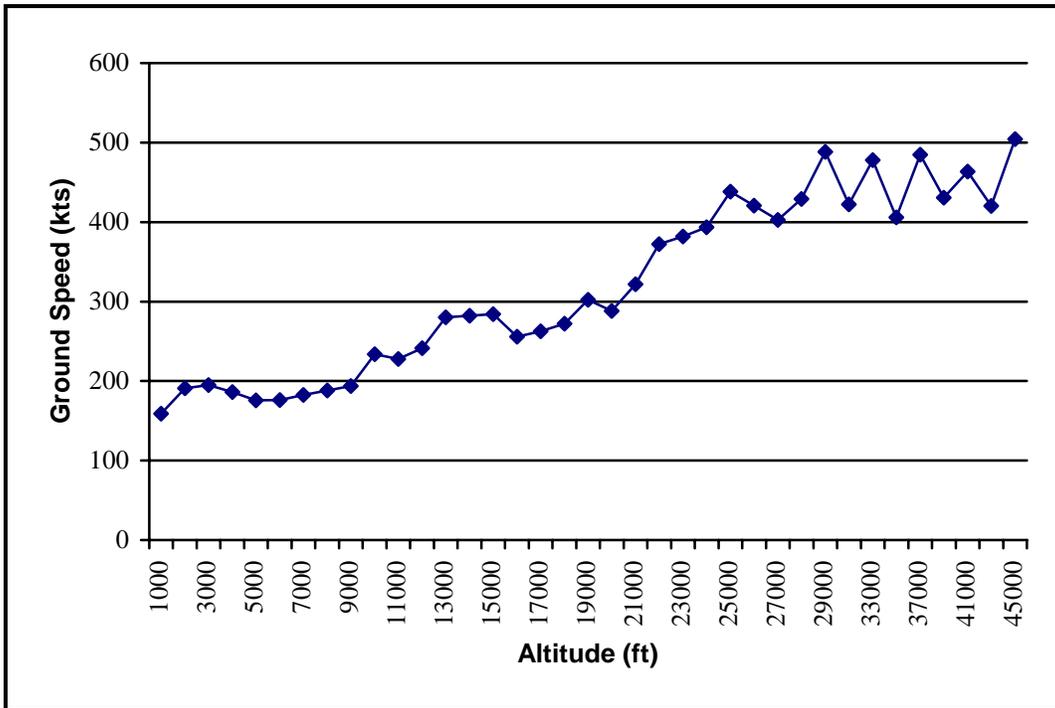


Figure 13: Average Ground Speed by Altitude for Hour 3

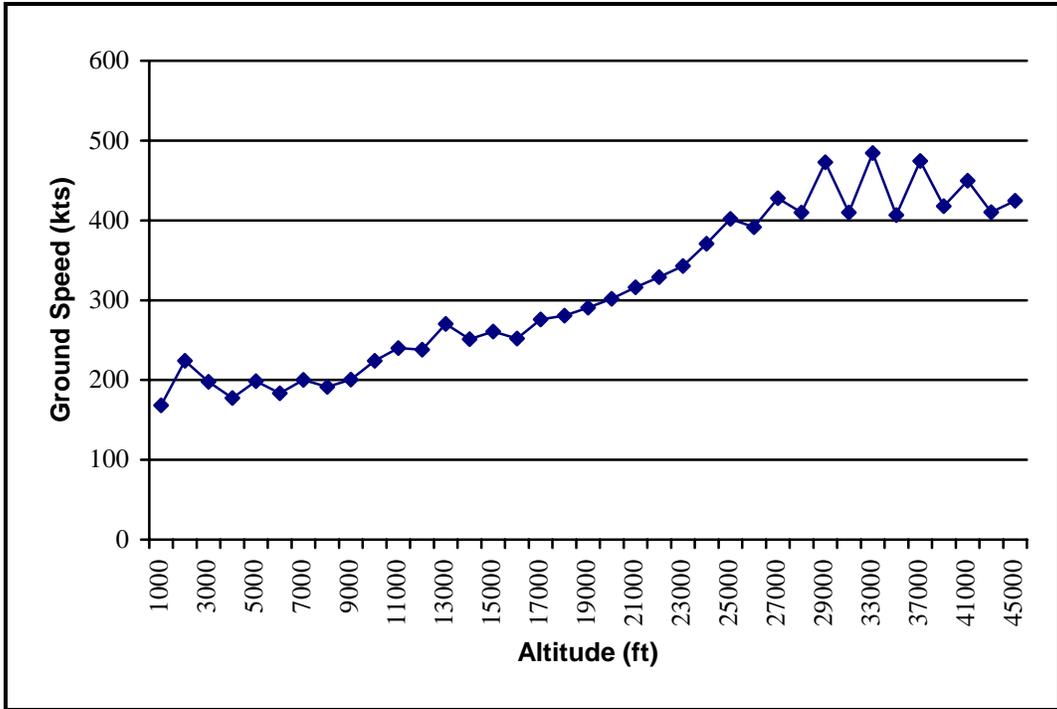


Figure 14: Average Ground Speed by Altitude for Hour 4

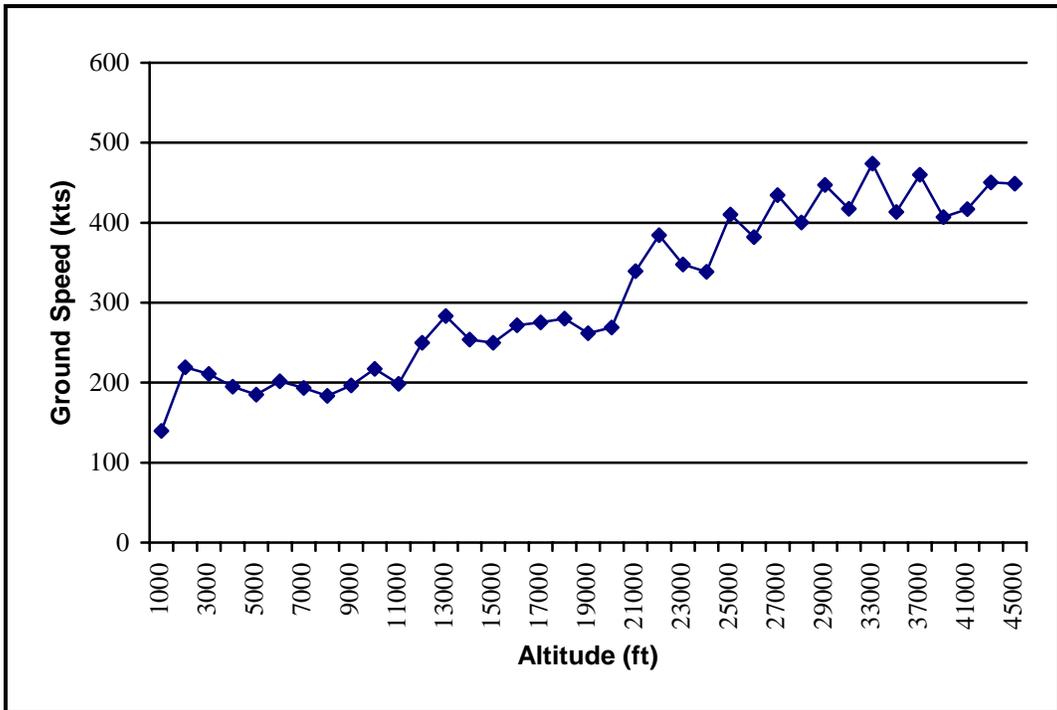


Figure 15: Average Ground Speed by Altitude for Hour 5

6.5 Center to APD Ratio

This section corresponds to Section 3.3.5 of Reference[1].

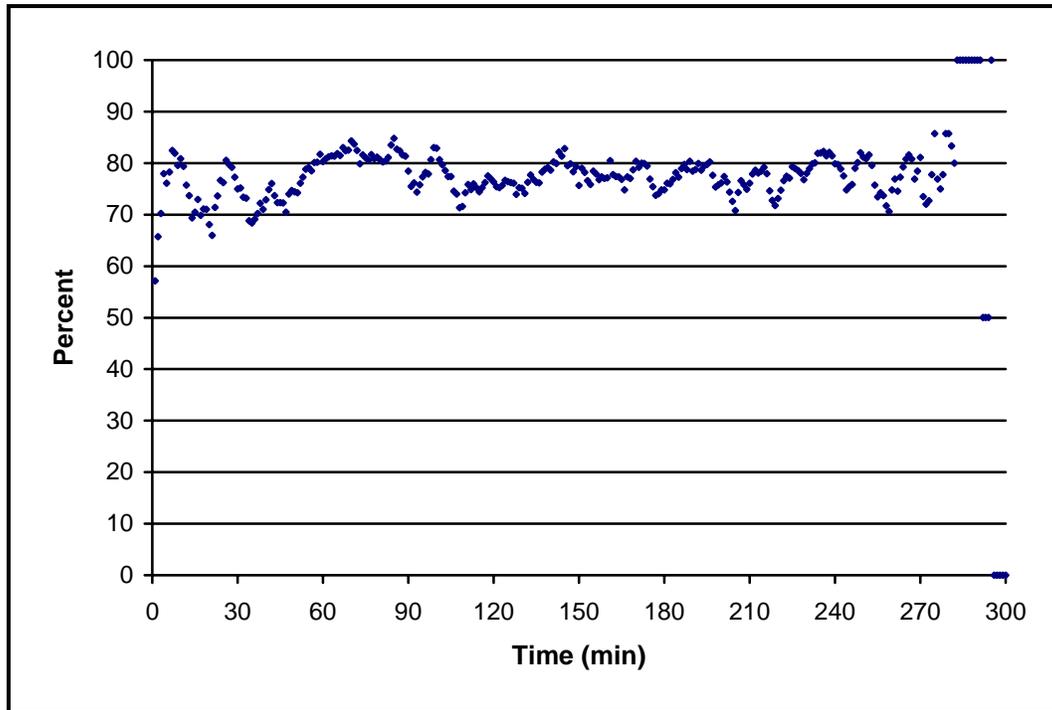


Figure 16: Percentage of Track Points in Center to APD Zone per Minute Increment

6.6 Interim Altitude Messages

This section corresponds to Section 3.3.6 of Reference[1].

Table 11: Statistics on Interim Altitude Messages⁵

Flight Count	Average	Standard Deviation	Maximum Count	Minimum Count
1187	2.906	1.148	8	1

6.7 Amendment Messages

This section corresponds to Section 3.3.7 of Reference[1].

Table 12: Statistics on Amendment Messages per Flight⁶

Flight Count	Average	Standard Deviation	Maximum Count	Minimum Count
825	1.987	1.296	10	1

⁵ Statistics on flights with interim altitude messages only

⁶ Statistics on flights with flight plan amendments only

6.8 Air Traffic Maneuvers

This section corresponds to Section 3.3.8 of Reference[1]. Detailed statistics on air traffic maneuvers are provided in Appendix C.

Table 13: Total Track Report Maneuver Count by Vertical and Horizontal Phase of Flight

Vertical Phase	Horizontal Phase of Flight		Total
	STR	TURN	
ASC	8622	2001	10623
DES	9399	1996	11395
LEV	3755	2226	5981
Total	21776	6223	27999

Table 14: Percent breakdown of Flight Tracks by Vertical and Horizontal Phase

Vertical Phase	Horizontal Phase of Flight		Margin (%)
	STR (%)	TURN (%)	
ASC	30.794	7.147	37.941
DES	33.569	7.129	40.698
LEV	13.411	7.950	21.361
Margin (%)	77.774	22.226	100.000

7 Aircraft Distributions

This sections provides the metrics used to characterize the aircraft provided in the scenario. The selected metrics are aircraft type, model, navigational equipment, and the air carriers operating in the airspace. The section corresponds to Section 3.4 of Reference[1].

7.1 Aircraft Type

This section corresponds to Section 3.4.1 of Reference[1].

Table 15: Count by Aircraft Type

Aircraft Type	Count	Percentage of Total
J	1124	67.265
P	214	12.807
T	323	19.330
Unknown	10	0.598
Total	1671	100.000

7.2 Aircraft Models

This section corresponds to Section 3.4.2 of Reference[1]. A full listing and count of aircraft models is provided in Appendix D.

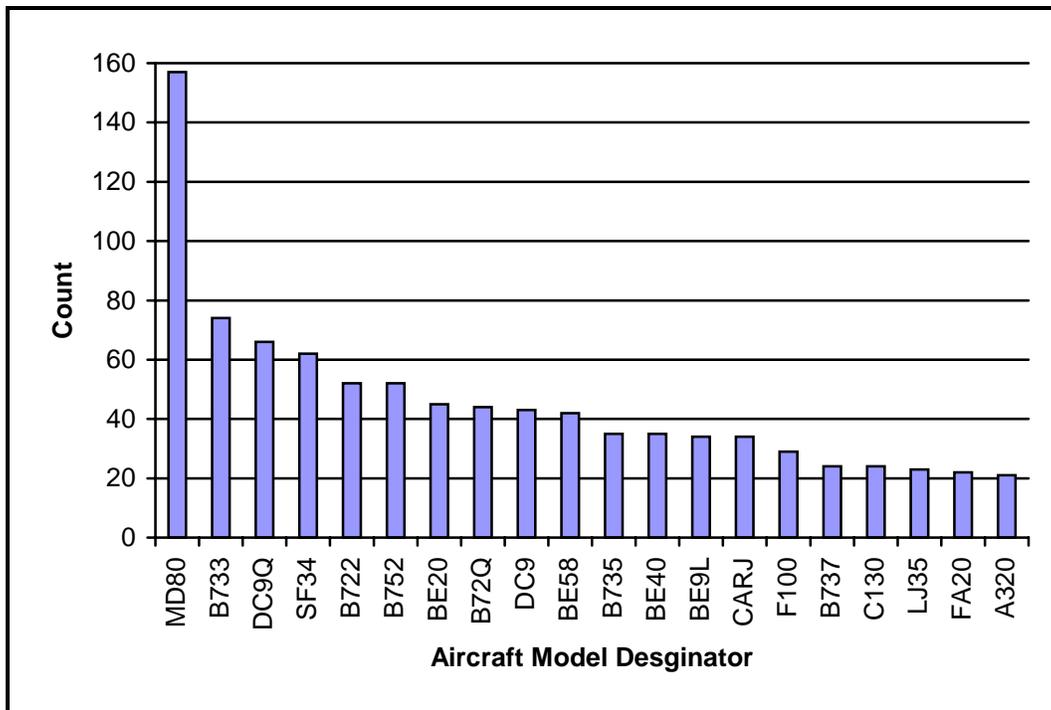


Figure 17: Count of Top Twenty Aircraft Models

7.3 Navigational Equipage

This section corresponds to Section 3.4.3 of Reference[1].

Table 16: Count by Aircraft Navigational Equipage Type

Nav. Equip. Designator	Count	Percentage of total
A	471	28.187
I	449	26.870
G	313	18.731
E	178	10.652
F	151	9.037
R	58	3.471
U	22	1.317
P	15	0.898
W	12	0.718
Unknown	2	0.120
Total	1671	100.000

7.4 Carrier Distribution

This section corresponds to Section 3.4.4 of Reference[1].

Table 17: Count by Carrier Type

Category	Count	Percentage of Total
Commercial	983	58.827
General Aviation	580	34.710
Other ⁷	108	6.463
Total	1671	100.000

⁷ Includes military and aircraft with unrecognized designators

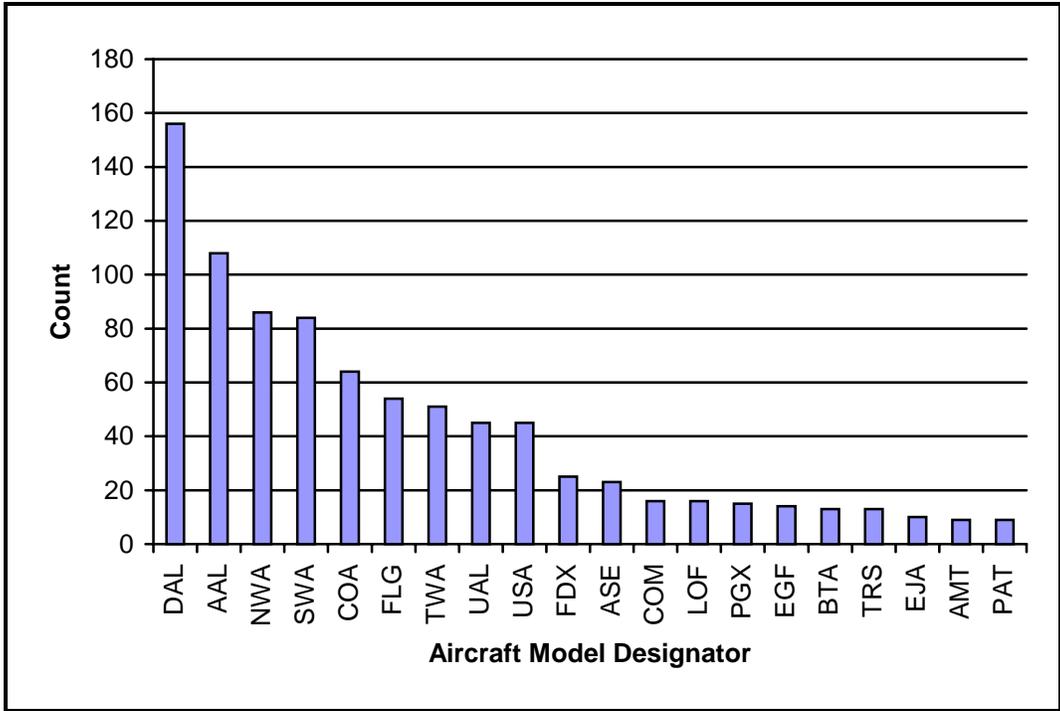


Figure 18: Count by Top Twenty Air Carriers

8 Flight Plan Adherence

This section provides statistics on lateral and vertical flight plan adherence and corresponds to Section 3.5 of Reference[1].

8.1 Lateral Flight Plan Adherence

This section corresponds to Section 3.5.1 of Reference[1].

Table 18: Statistics on Lateral Flight Plan Adherence by Altitude⁸

Upper Altitude (ft)	Flight Count	Max. Dist. Out (nm)	Min. Dist. Out (nm)	Average Dist. Out (nm)	Standard Dev.(nm)
10000	55	41	11	17.275	5.384
18000	52	51	13	23.478	8.657
33000	103	117	13	28.261	15.553
45000	52	65	14	26.592	8.342
Total	262				

8.2 Vertical Flight Plan Adherence

This section corresponds to Section 3.5.2 of Reference[1].

Table 19: Statistics on Vertical Flight Plan Adherence by Altitude⁹

Upper Altitude (ft)	Flight Count	Max. Dist. Out (ft)	Min. Dist. Out (ft)	Average Dist. Out (ft)	Standard Dev.(ft)
29000	727	43000	308	4171.266	3784.82
45000	269	21866	509	4726.549	3619.903
Total	996				

⁸ Statistics determined on tracks out of lateral adherence only.

⁹ Statistics were determined on tracks out of vertical adherence only.

9 Interfacility Traffic Flow

This section corresponds to Section 3.6 of Reference[1]. Table 20 duplicates Table 3.6-1 in reference and provides definitions for cells in Tables 21 and 22.

Table 20: Matrix of Traffic Sources in Scenario

Input - Flights into ZME	Output - Flights from ZME
Starts in ZID	Ends in ZID
Starts in ZME	Ends in ZME
Starts in Other Center	Ends in Other Center

Table 21: Statistics on Flights into ZME Airspace per minute

Input Flights	Average	Standard Deviation	Maximum Count	Minimum Count
From ZID	29.887	14.344	47	0
From ZME	61.563	26.143	102	0
From Other	116.527	55.302	165	0

Table 22: Statistics on Flights from ZME Airspace per minute

Output Flights	Average	Standard Deviation	Maximum Count	Minimum Count
To ZID	28.837	16.237	57	0
To ZME	68.977	35.360	164	0
To Other	110.163	54.615	173	0

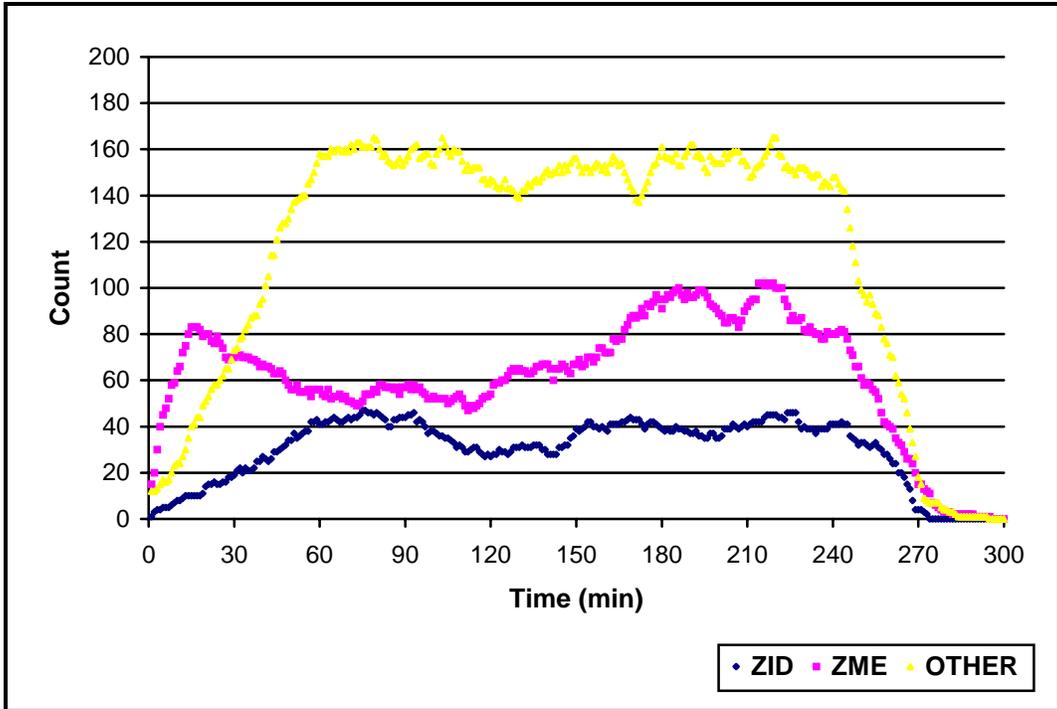


Figure 19: Flights into ZME from Legend Centers

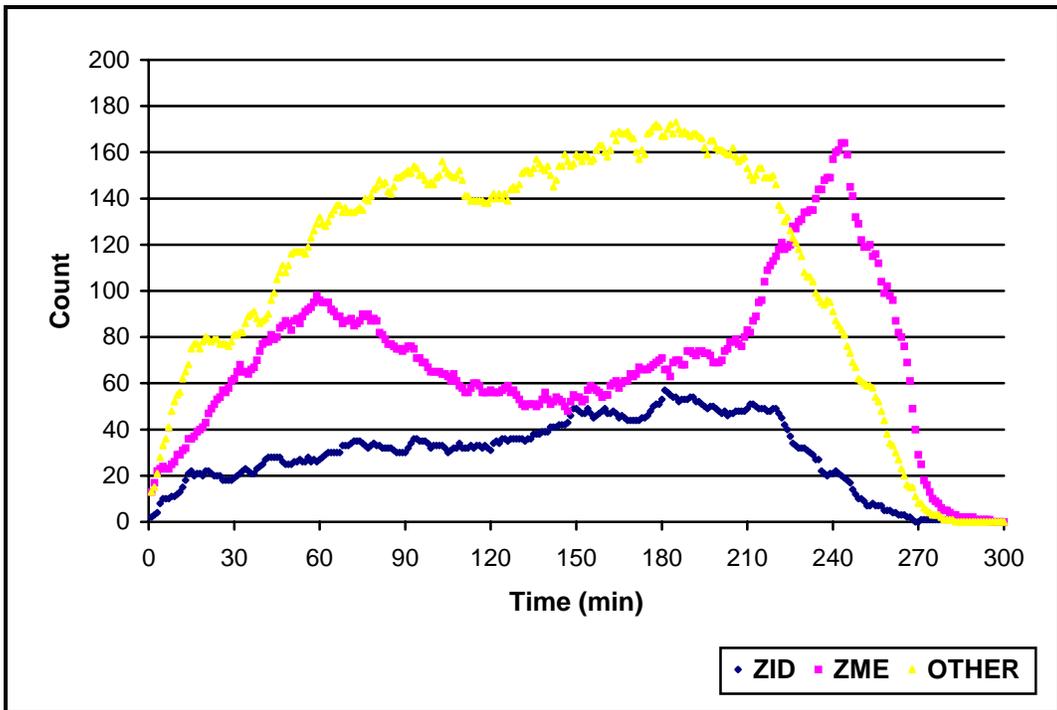


Figure 20: Flights from ZME to Legend Centers

10 Weather Variations

This section corresponds to Section 3.7 of Reference[1]. See the following document,

Kelly, Betty A., *User Request Evaluation Tool Core Capability Limited Deployment Accuracy Scenario Weather Forecast Deviation Study*, FAA William J. Hughes Technical Center / ACT-250, Atlantic City, New Jersey.

Appendix A: Supplement to Section 6.1 - Aircraft Traffic Density

Table 23: Statistics on Aircraft Encounters by Altitude Interval for All Hours

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	2	16.601	16.020
3000	0	0.000	0.000
4000	9	16.375	8.192
5000	13	14.448	9.204
6000	22	17.609	7.992
7000	29	17.639	9.176
8000	20	17.509	8.795
9000	26	14.335	8.646
10000	18	21.118	7.119
11000	30	18.903	6.734
12000	21	16.403	8.777
13000	15	18.923	8.394
14000	10	19.533	9.108
15000	31	16.932	8.652
16000	46	17.554	8.318
17000	41	19.654	7.333
18000	38	17.385	7.755
19000	35	17.356	8.749
20000	39	18.795	6.385
21000	17	15.650	7.768
22000	21	20.012	6.420
23000	23	18.794	7.363
24000	23	18.379	6.571
25000	28	14.556	8.230
26000	40	18.190	6.754
27000	89	17.749	7.818
28000	102	18.062	8.095
29000	104	16.965	7.421
31000	191	16.336	8.278
33000	275	16.216	8.379
35000	138	16.395	8.457
37000	129	15.752	8.421
39000	54	17.703	8.303
41000	57	16.754	8.393
43000	5	15.669	4.622
45000	0	0.000	0.000
Total	1741		

Table 24: Statistics on Aircraft Encounters by Altitude for Hour 1

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	0	0.000	0.000
4000	2	15.289	5.073
5000	2	16.563	11.568
6000	3	16.052	11.872
7000	4	20.064	9.265
8000	6	22.676	5.873
9000	8	15.933	6.767
10000	0	0.000	0.000
11000	4	18.392	9.901
12000	6	14.655	7.486
13000	3	16.440	6.437
14000	0	0.000	0.000
15000	3	4.979	6.674
16000	11	18.031	8.398
17000	5	19.892	11.699
18000	6	11.597	7.862
19000	5	17.396	7.674
20000	8	19.220	5.999
21000	2	23.787	0.703
22000	2	21.009	6.898
23000	5	22.335	4.687
24000	1	21.292	0.000
25000	4	9.037	6.888
26000	3	18.192	10.032
27000	2	23.511	0.764
28000	8	17.051	8.706
29000	17	17.854	8.590
31000	35	15.716	7.557
33000	33	16.583	9.180
35000	19	18.789	7.318
37000	11	17.339	8.570
39000	3	14.667	12.012
41000	5	14.410	3.899
43000	1	10.919	0.000
45000	0	0.000	0.000
Total	227		

Table 25: Statistics on Aircraft Encounters by Altitude for Hour 2

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	0	0.000	0.000
4000	1	3.772	0.000
5000	5	11.505	10.890
6000	7	15.418	5.999
7000	6	12.426	9.052
8000	2	27.276	0.849
9000	5	8.367	7.505
10000	4	19.467	6.214
11000	3	23.756	4.894
12000	7	13.941	7.191
13000	7	21.337	7.533
14000	7	20.235	10.593
15000	3	16.970	0.298
16000	2	27.140	1.497
17000	2	23.813	2.839
18000	5	21.606	4.972
19000	8	16.452	10.351
20000	10	17.802	7.788
21000	1	9.177	0.000
22000	5	19.719	8.640
23000	10	15.205	7.996
24000	4	19.301	6.619
25000	9	15.977	10.626
26000	6	20.370	4.537
27000	26	15.034	8.767
28000	31	17.738	8.247
29000	25	18.324	6.631
31000	53	16.840	8.161
33000	49	17.103	8.758
35000	37	15.386	7.675
37000	44	15.931	8.164
39000	28	19.513	7.760
41000	21	18.180	7.621
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	433		

Table 26: Statistics on Aircraft Encounters by Altitude for Hour 3

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	0	0.000	0.000
4000	1	23.843	0.000
5000	1	17.552	0.000
6000	11	19.509	8.731
7000	6	13.340	8.352
8000	1	13.966	0.000
9000	7	15.723	10.764
10000	3	19.259	6.625
11000	10	18.641	7.427
12000	2	16.057	14.218
13000	1	26.881	0.000
14000	0	0.000	0.000
15000	5	18.698	7.713
16000	13	16.466	9.190
17000	16	17.394	7.155
18000	10	18.315	8.512
19000	11	17.568	10.693
20000	11	17.529	6.172
21000	11	13.815	8.307
22000	3	18.116	1.773
23000	1	26.089	0.000
24000	0	0.000	0.000
25000	7	12.213	3.822
26000	12	17.879	6.568
27000	17	19.157	7.003
28000	15	20.228	8.792
29000	28	16.560	8.061
31000	38	15.593	8.487
33000	88	16.723	8.733
35000	44	16.180	9.297
37000	41	15.016	8.830
39000	9	21.154	5.031
41000	5	14.507	11.319
43000	1	17.731	0.000
45000	0	0.000	0.000
Total	429		

Table 27: Statistics on Aircraft Encounters by Altitude for Hour 4

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	2	16.601	16.020
3000	0	0.000	0.000
4000	4	15.133	6.765
5000	5	15.924	9.161
6000	0	0.000	0.000
7000	11	20.854	9.127
8000	8	16.146	7.556
9000	5	15.874	10.047
10000	7	23.740	5.191
11000	10	18.269	6.503
12000	6	21.137	10.512
13000	4	14.572	11.026
14000	3	17.894	5.560
15000	17	16.799	8.567
16000	20	17.041	7.900
17000	17	21.328	6.423
18000	14	17.218	7.660
19000	9	17.100	7.109
20000	10	20.839	5.772
21000	2	19.082	5.268
22000	10	20.076	6.978
23000	5	21.435	6.979
24000	14	16.433	6.817
25000	8	17.767	7.878
26000	18	17.906	7.480
27000	36	17.859	7.867
28000	43	17.738	7.840
29000	31	15.988	7.046
31000	47	14.622	8.442
33000	70	14.513	7.851
35000	27	16.425	8.958
37000	25	15.476	9.284
39000	11	13.275	9.499
41000	22	15.988	9.094
43000	3	16.566	5.303
45000	0	0.000	0.000
Total	524		

Table 28: Statistics on Aircraft Encounters by Altitude for Hour 5

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	0	0.000	0.000
4000	1	28.649	0.000
5000	0	0.000	0.000
6000	1	16.707	0.000
7000	2	23.648	5.034
8000	3	5.481	6.504
9000	1	13.969	0.000
10000	4	19.576	11.794
11000	3	17.721	2.768
12000	0	0.000	0.000
13000	0	0.000	0.000
14000	0	0.000	0.000
15000	3	26.658	2.826
16000	0	0.000	0.000
17000	1	17.837	0.000
18000	3	19.606	6.645
19000	2	20.869	6.072
20000	0	0.000	0.000
21000	1	19.169	0.000
22000	1	24.532	0.000
23000	2	17.632	7.224
24000	4	23.540	3.777
25000	0	0.000	0.000
26000	1	13.937	0.000
27000	8	21.642	3.644
28000	5	17.974	8.638
29000	3	14.497	6.326
31000	18	22.098	7.224
33000	35	16.758	7.057
35000	11	16.435	8.734
37000	8	17.212	5.593
39000	3	9.730	0.780
41000	4	19.225	10.656
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	128		

Appendix B: Supplement to Section 6.4 - Aircraft Ground Speed

Table 29: Statistics on Ground Speed by Altitude for All Hours

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	26	161.877	44.965
2000	139	205.540	71.709
3000	310	198.332	55.739
4000	449	188.233	57.865
5000	523	190.392	54.100
6000	580	183.517	47.355
7000	631	194.303	50.243
8000	722	193.710	55.604
9000	712	201.117	55.821
10000	700	228.865	70.462
11000	679	233.105	68.284
12000	660	241.803	69.665
13000	633	262.708	70.709
14000	619	260.765	76.505
15000	615	264.843	67.766
16000	606	258.759	67.548
17000	598	272.983	67.601
18000	584	273.732	74.052
19000	556	295.760	77.704
20000	540	287.173	76.087
21000	509	324.030	76.748
22000	502	353.786	86.853
23000	492	359.548	80.608
24000	513	377.980	81.753
25000	497	405.646	79.323
26000	508	401.923	72.773
27000	534	427.156	87.700
28000	544	419.133	58.106
29000	533	475.163	48.252
31000	515	418.480	42.679
33000	488	476.412	40.502
35000	342	406.885	42.420
37000	260	478.675	46.357
39000	171	411.778	47.772
41000	119	460.069	48.060
43000	45	422.531	43.501
45000	12	468.615	42.838

Table 30: Statistics on Ground Speed by Altitude for Hour 1

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	2	134.444	4.978
2000	18	177.852	37.098
3000	61	192.886	50.422
4000	95	191.320	52.115
5000	109	196.806	52.313
6000	121	176.107	45.873
7000	130	201.088	54.435
8000	140	190.640	56.631
9000	138	202.454	56.115
10000	136	223.660	79.347
11000	129	251.516	71.016
12000	131	241.931	65.885
13000	128	253.741	68.165
14000	124	271.372	80.020
15000	127	260.627	77.559
16000	129	258.811	72.966
17000	123	269.733	82.410
18000	119	264.455	77.307
19000	116	301.594	84.170
20000	109	309.499	87.136
21000	103	346.843	89.042
22000	99	372.531	73.675
23000	98	362.101	79.671
24000	99	405.623	56.948
25000	99	395.521	72.436
26000	91	410.621	71.071
27000	103	421.909	72.445
28000	105	423.697	63.404
29000	109	474.816	44.856
31000	115	415.627	47.129
33000	106	473.785	42.695
35000	77	409.956	48.272
37000	54	486.654	51.570
39000	29	395.780	49.122
41000	25	470.260	36.124
43000	10	452.840	41.713
45000	4	434.355	27.468

Table 31: Statistics on Ground Speed by Altitude for Hour 2

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	5	164.917	13.635
2000	30	175.846	48.595
3000	82	202.678	40.072
4000	125	201.876	44.881
5000	150	196.949	44.877
6000	167	188.511	45.784
7000	166	195.249	49.345
8000	185	207.134	60.858
9000	182	211.452	56.433
10000	177	239.293	70.272
11000	166	241.683	68.010
12000	161	244.390	76.015
13000	153	249.090	70.026
14000	147	257.110	81.555
15000	143	266.522	71.032
16000	142	277.081	75.847
17000	138	295.054	85.751
18000	137	274.496	67.151
19000	131	302.881	83.116
20000	131	265.096	73.227
21000	126	317.610	70.871
22000	121	343.010	82.534
23000	119	372.440	76.628
24000	127	378.948	78.239
25000	124	391.926	77.328
26000	124	404.408	58.677
27000	130	447.941	70.160
28000	147	422.424	39.840
29000	152	468.975	48.178
31000	148	425.835	39.651
33000	129	464.755	42.265
35000	104	404.562	44.793
37000	87	475.035	47.238
39000	59	403.455	46.656
41000	36	474.509	37.552
43000	17	415.357	46.073
45000	4	471.357	38.424
Total	5	164.917	13.635

Table 32: Statistics on Ground Speed by Altitude for Hour 3

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	7	158.833	36.500
2000	43	191.067	65.436
3000	77	194.771	58.574
4000	103	185.947	59.741
5000	126	175.818	53.218
6000	149	175.938	43.941
7000	163	182.328	49.104
8000	188	188.171	49.149
9000	183	193.784	53.444
10000	179	233.762	69.821
11000	167	227.609	60.821
12000	163	241.453	74.886
13000	152	280.301	74.855
14000	144	282.024	72.143
15000	145	284.366	71.146
16000	143	255.799	68.230
17000	142	262.535	60.625
18000	136	272.363	70.284
19000	127	302.121	77.749
20000	124	288.113	74.277
21000	119	321.903	69.644
22000	126	372.446	80.114
23000	119	381.973	78.297
24000	129	393.483	70.356
25000	124	438.422	62.502
26000	134	420.857	64.070
27000	146	402.588	103.398
28000	148	429.077	45.258
29000	146	488.404	43.660
31000	149	422.379	37.681
33000	147	477.925	36.815
35000	113	405.858	42.332
37000	89	484.821	48.359
39000	50	430.682	49.575
41000	34	463.442	46.821
43000	15	420.093	37.846
45000	4	504.408	11.307

Table 33: Statistics on Ground Speed by Altitude for Hour 4

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	10	168.206	52.479
2000	47	223.896	77.225
3000	86	197.871	62.007
4000	115	177.324	61.561
5000	141	198.490	63.265
6000	152	183.200	49.287
7000	168	200.110	45.703
8000	206	191.510	53.830
9000	209	200.720	56.329
10000	213	224.243	66.419
11000	210	240.021	67.969
12000	200	238.016	63.676
13000	187	270.289	66.529
14000	191	251.129	71.731
15000	191	260.906	61.075
16000	188	251.990	59.198
17000	180	276.010	58.893
18000	170	280.683	78.726
19000	163	290.829	69.495
20000	159	301.650	66.148
21000	147	315.994	74.054
22000	145	328.797	94.855
23000	144	342.676	79.130
24000	145	370.831	85.775
25000	140	401.934	84.645
26000	152	391.469	81.867
27000	161	427.576	86.427
28000	147	409.870	73.058
29000	139	472.746	42.273
31000	140	409.649	46.185
33000	138	484.260	36.665
35000	97	406.588	36.649
37000	78	474.347	36.062
39000	54	417.865	42.535
41000	52	449.811	52.519
43000	17	410.374	42.741
45000	2	424.489	37.413

Table 34: Statistics on Ground Speed by Altitude for Hour 5

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	2	139.800	61.345
2000	8	219.091	80.998
3000	29	210.732	69.992
4000	46	194.877	70.955
5000	58	185.046	50.053
6000	69	201.706	51.052
7000	71	193.374	54.546
8000	77	183.240	52.515
9000	67	196.631	55.454
10000	69	217.203	63.770
11000	66	198.619	65.185
12000	59	250.024	65.396
13000	54	283.347	73.160
14000	53	253.649	74.182
15000	52	249.781	52.636
16000	50	271.554	69.012
17000	51	275.269	65.675
18000	51	280.304	79.634
19000	51	261.884	66.050
20000	48	269.106	77.759
21000	43	339.409	99.184
22000	45	384.268	77.373
23000	41	347.587	85.273
24000	47	338.594	99.234
25000	43	410.058	88.453
26000	49	381.846	74.667
27000	50	434.473	92.755
28000	56	400.352	75.136
29000	52	447.069	81.354
31000	69	417.224	39.948
33000	74	473.925	49.061
35000	51	413.573	34.888
37000	33	459.864	52.502
39000	24	406.852	32.901
41000	21	416.838	54.461
43000	4	450.538	19.584
45000	1	448.625	4.209

Appendix C: Supplement to Section 6.8 - Air Traffic Maneuvers

Table 35: Count of Maneuvers by Altitude, Vertical and Horizontal Phase of Flight

Upper Altitude (ft)	Vertical Phase	Horizontal Phase of Flight	
		STR	TURN
1000	ASC	11	15
	DES	3	3
	LEV	7	10
2000	ASC	52	57
	DES	39	41
	LEV	67	80
3000	ASC	119	128
	DES	85	94
	LEV	176	152
4000	ASC	120	96
	DES	140	120
	LEV	259	158
5000	ASC	137	79
	DES	173	108
	LEV	335	137
6000	ASC	133	91
	DES	210	120
	LEV	384	118
7000	ASC	144	75
	DES	253	116
	LEV	383	105
8000	ASC	139	75
	DES	349	172
	LEV	373	98
9000	ASC	78	42
	DES	340	185
	LEV	371	66
10000	ASC	148	57
	DES	353	167
	LEV	363	81
11000	ASC	102	49
	DES	381	97
	LEV	354	65
12000	ASC	85	36
	DES	370	49
	LEV	347	41
13000	ASC	41	17
	DES	360	37
	LEV	334	38

14000	ASC	38	20
	DES	355	43
	LEV	327	36
15000	ASC	48	24
	DES	347	48
	LEV	333	34
16000	ASC	74	43
	DES	335	44
	LEV	316	29
17000	ASC	71	38
	DES	326	33
	LEV	296	41
18000	ASC	58	30
	DES	314	23
	LEV	297	34
19000	ASC	45	27
	DES	307	26
	LEV	288	36
20000	ASC	51	26
	DES	296	23
	LEV	274	44
21000	ASC	40	26
	DES	278	17
	LEV	260	34
22000	ASC	48	26
	DES	272	31
	LEV	253	41
23000	ASC	57	34
	DES	266	32
	LEV	245	42
24000	ASC	115	63
	DES	260	32
	LEV	258	37
25000	ASC	67	29
	DES	259	28
	LEV	279	38
26000	ASC	79	43
	DES	258	27
	LEV	285	59
27000	ASC	116	73
	DES	267	44
	LEV	307	59
28000	ASC	172	79
	DES	261	40

	LEV	321	55
29000	ASC	187	96
	DES	254	39
	LEV	320	57
31000	ASC	235	131
	DES	249	42
	LEV	315	53
33000	ASC	282	192
	DES	217	49
	LEV	255	43
35000	ASC	209	122
	DES	149	23
	LEV	163	29
37000	ASC	181	123
	DES	120	20
	LEV	122	19
39000	ASC	117	62
	DES	88	10
	LEV	68	13
41000	ASC	103	74
	DES	62	13
	LEV	40	9
43000	ASC	43	21
	DES	18	4
	LEV	18	3
45000	ASC	10	7
	DES	8	1
	LEV	6	2

Appendix D: Supplement to Section 7.2 - Aircraft Models

Table 36: Count and Percentage of Aircraft by Model Type

Model Type	Aircraft Count	Percent of Total
MD80	157	9.396
B733	74	4.428
DC9Q	66	3.950
SF34	62	3.710
B722	52	3.112
B752	52	3.112
BE20	45	2.693
B72Q	44	2.633
DC9	43	2.573
BE58	42	2.513
B735	35	2.095
BE40	35	2.095
BE9L	34	2.035
CARJ	34	2.035
F100	29	1.735
B737	24	1.436
C130	24	1.436
LJ35	23	1.376
FA20	22	1.317
A320	21	1.257
B732	21	1.257
B73Q	20	1.197
C560	20	1.197
B763	19	1.137
H25B	18	1.077
C650	17	1.017
PA31	17	1.017
T38	17	1.017
E120	16	0.958
DC10	15	0.898
E145	14	0.838
C210	13	0.778
C310	13	0.778
C421	13	0.778
JS32	13	0.778
BE30	12	0.718
BE36	12	0.718
B190	11	0.658
C550	11	0.658

MU2	9	0.539
BA46	8	0.479
C500	8	0.479
FA10	8	0.479
L101	8	0.479
LJ25	8	0.479
WW24	8	0.479
A306	7	0.419
B762	7	0.419
C441	7	0.419
LJ55	7	0.419
LJ60	7	0.419
SBR1	7	0.419
A319	6	0.359
AT45	6	0.359
B772	6	0.359
C340	6	0.359
C414	6	0.359
JS41	6	0.359
LJ31	6	0.359
PA34	6	0.359
ASTR	5	0.299
B350	5	0.299
C525	5	0.299
GLF2	5	0.299
PAY2	5	0.299
SW3	5	0.299
AT38	4	0.239
BE10	4	0.239
C172	4	0.239
C208	4	0.239
C402	4	0.239
C501	4	0.239
C750	4	0.239
GLF3	4	0.239
H25A	4	0.239
H60	4	0.239
HS25	4	0.239
JS31	4	0.239
LR35	4	0.239
MD90	4	0.239
SH33	4	0.239
SW4	4	0.239
AC69	3	0.180
B734	3	0.180

BE60	3	0.180
BE99	3	0.180
C12	3	0.180
C141	3	0.180
C177	3	0.180
CL64	3	0.180
DC8Q	3	0.180
LJ45	3	0.180
M20	3	0.180
P31T	3	0.180
P32R	3	0.180
PA28	3	0.180
PA46	3	0.180
PAY3	3	0.180
A124	2	0.120
A310	2	0.120
A340	2	0.120
AC90	2	0.120
AC9T	2	0.120
AEST	2	0.120
AT43	2	0.120
AT72	2	0.120
B2	2	0.120
B52	2	0.120
B744	2	0.120
BE33	2	0.120
C401	2	0.120
CL65	2	0.120
D328	2	0.120
DC87	2	0.120
E6	2	0.120
F2TH	2	0.120
FA50	2	0.120
H25C	2	0.120
KR35	2	0.120
MD11	2	0.120
P12	2	0.120
P3	2	0.120
PA24	2	0.120
PA44	2	0.120
PAY1	2	0.120
PC12	2	0.120
n/a	2	0.120
2T38	1	0.060
A10	1	0.060

AA5	1	0.060
AC50	1	0.060
AC70	1	0.060
AC95	1	0.060
B1	1	0.060
B55	1	0.060
B721	1	0.060
B727	1	0.060
B738	1	0.060
B73B	1	0.060
BE9T	1	0.060
C135	1	0.060
C160	1	0.060
C17	1	0.060
C180	1	0.060
C182	1	0.060
C335	1	0.060
C337	1	0.060
C551	1	0.060
C82R	1	0.060
CV58	1	0.060
CVLT	1	0.060
DA50	1	0.060
DA90	1	0.060
DC86	1	0.060
E3TF	1	0.060
F15	1	0.060
F16	1	0.060
F900	1	0.060
FA90	1	0.060
FJ50	1	0.060
GC1	1	0.060
GLF5	1	0.060
HF32	1	0.060
JSTA	1	0.060
K35R	1	0.060
L29B	1	0.060
L329	1	0.060
LC30	1	0.060
LR24	1	0.060
LR25	1	0.060
M20P	1	0.060
M20T	1	0.060
MU3	1	0.060
MU30	1	0.060

MXT7	1	0.060
P210	1	0.060
P28R	1	0.060
PA27	1	0.060
PA30	1	0.060
SH36	1	0.060
SW2	1	0.060
T37	1	0.060
Total	1671	100.000